A DAY AT A COACH-FACTORY.

[Coach-Makers' Loft.

ACCORDING to the information of Stow, the business of *coach-making* arose more suddenly in England than has commonly been the case in the annals of our manufactures. "In the yeere 1564," says he, "Guylliam Boonen, a Dutchman, became the queene's coachmanne, and was the first that brought the use of coaches into England. And after a while, divers great ladies, with as great jealousie of the queene's displeasure, made them coaches, and rid in them up and downe the countries, to the great admiration of all the beholders; but then by little and little they grew usual among the nobilitie, and others of sort, and within twentie yeeres became a great trade of coach-making." The fashion gained a permanent footing, notwithstanding the opposition of watermen and chairmen, and the vituperation of Taylor the 'water-poet,' who reviled the new-fashioned coach as a "great hypocrite, for it hath a cover for knavery, and curtains to vaile and shadow any wickedness. Besides, like a perpetual cheater, it wears two bootes and no spurs, sometime having two pair of legs to one boot, and oftentimes (against nature) it makes faire ladies weare the boote; and if you note, they are carried back to back, like people surprised by pyrats, to be tyed in that miserable manner, and thrown overboard into the sea. Moreover, it makes people imitate sea-crabs, in being drawn sideway, as they are when they sit in the boot of the coach; and it is a dangerous kinde of carriage for the commonwealth, if it be considered."

We shall attempt to convey to the reader some idea of the mode of constructing these "great hypocrites;" but that our account must be nothing more than a cursory glance will be evident when it is considered that the construction of a coach requires the aid of coach-body makers, carriage-makers, coach-smiths, coach-platers, coach-beaders, coach-carvers, coach-trimmers, coach-lace makers, coach-lamp makers, harness-makers, coach-wheelwrights, coach-painters, herald-painters, and various others whose occupations form more or less distinct branches of trade. The more prominent only of these can be here noticed.

Perhaps the simplest mode of viewing the construction of a coach is in reference to the materials used. These are principally timber, iron, plated metal, leather, paint, varnish, and woven materials. The main parts of a vehicle are constructed of wood, whether in relation to the body (the part in which the travellers are seated), the under frame-work, or the wheels. Iron is however used in considerable quantity, not only for the springs, but in almost every part of the vehicle, in order to enable the latter to bear the very severe strain to which it is subject. Plated metal is used principally for ornament, such as beadings, &c., in addition to its employment for handles, hinges, and various other small pieces of mechanism. Leather is used for covering the upper part of the body of the best coaches, for suspending the body in its supporting frame, for attaching the horses to the vehicle, and in a small degree for the internal trimmings of the coach. Paint and varnish are of course used for the customary purposes, in preserving and beautifying the surfaces of the wood and iron. Woven materials, such as carriage-lace, fine woollen-cloth, silk, &c., are employed in the internal decoration or 'trimming' of a coach.

It may now be asked whether these various operations are ever carried on under one roof, and by one establishment; or whether, in order to see the different

processes of coach-making, it would be necessary to visit as many different tradesmen as were enumerated in a former paragraph. No one establishment makes all the various parts of a coach; and great differences exist in the extent to which the connection of the branches is carried. Some of the smaller manufacturers merely put together the parts which have been procured ready made from other persons, while the larger firms embrace several different departments, whereby the parts of a coach are, for the most part, entirely made within one factory. We have hence thought it desirable to describe the operations of an establishment of the latter kind; and have been favoured by Messrs. Pearce and Countze, of Long Acre, with permission to select their factory for this purpose; a factory conducted on a large scale, and embracing a great number of departments.

We are not antiquarians enough to know whether Long Acre has, from the time of its formation, been a bazaar for coach-makers, but certain it is that at the present day coach-making operations form the most remarkable feature in that street. Out of about a hundred and forty houses which the street contains, more than fifty are occupied either by coachmakers, so designated, or by manufacturers of the lamps, fringe, harness, &c. for coaches. The firm which we have just named occupies two of these houses, together with a large range of back premises, adjacent to Cross Lane. We will rapidly glance through the factory before detailing the processes of manufacture.

The first portion of the premises is occupied, as in other factories of a similar kind, by finished carriages of various forms, such as coaches, chariots, phaetons, gigs, cabriolets, curricles, tilburys, &c. Behind this is an open court or quadrangle, to which entrance is obtained from Cross Lane, and from whence stairs and passages lead to the various rooms of the factory, which are seen on all four sides of the central court. Beyond this, still on a level with the ground, is a large ware-room or shop, into which the carriages are lowered when completed in the upper rooms. A trap-door of large size is seen overhead, from which descends an inclined wooden railroad or 'shoot,' for the lowering of the carriages, by the aid of tackle in the room above. Still farther towards the north, and extending to the narrow street called Brokers' Row, is the timber store-room, around which on every side are stored the mahogany, oak, ash, elm, deal, and other woods employed in the making of carriages. Most of this timber is kept here several years before use, in order to ensure its dryness; and it is cut into planks in saw-pits, with which this part of the premises is provided.

Returning nearer to the front of the building, we ascend a staircase which leads to the workshops and show-rooms on the first floor. At the head of the stairs is the 'harness department,' where the numerous traces, bands, straps, and other articles of leather for carriages are made. The middle of the room is filled with harness in a more or less prepared state; and around the room are small work-benches, each occupied by one man. All the harness required for the carriages is made within the building. Beyond the harness-workshop is a gallery or passage, lighted on one side by a row of windows, and lined on the other by glass cases filled with specimens of the more decorative parts of carriage furniture and harness. This gallery leads to the 'carriage show-loft,' a very extensive room filled with carriages nearly in a finished state; it is occupied, as the name imports, principally as a show-room; but some parts of a carriage are fitted to their proper places in this room, and there are mechanical means for receiving carriages from the floor above, and lowering them to the floor below.

A door on the left-hand side of the 'show-loft' leads to the 'smith's shop,' a large square building of two stories, fitted up with every convenience for the manufacture of iron-work. Almost every particle of iron used in the construction of carriages by this firm is made within their own premises: axles, cranes, bars, stays, plates, bolts, and various other forms in which the metal is used, are made in this shop. The upper story is a 'filing and turning' shop, and the lower a 'forging' shop. The latter is provided with eight forges or furnaces, ranged conveniently round the sides; and near each forge is a gas-branch, together with anvils and the requisite utensils, for the working of the men in the evening as well as by day. All the iron and steel employed is brought in in the form of bars two or three inches wide; the former to be worked into axles, bolts, &c., and the latter into springs, which form a very important part of the fittings of a coach. When the various articles of steel and iron are brought to a certain stage in this lower shop, they are carried to the upper, where there are two or three powerful lathes for turning the metal, together with vices and benches at which men are engaged in filing and finishing the metal-work. The smiths and their assistants, of whom we saw between twenty and thirty in these two shops, form a class of workmen who can command higher wages than almost any other workers in iron.

The lower floor of the smith's shop communicates with a timber-loft, and the upper floor with the show-loft, into which we now return, and proceed up another flight of stairs to the next higher story of the factory. This story is occupied as the 'coach-making loft,' and is represented in our frontispiece. All the wood-work belonging to the coaches, the wheels and some smaller portions excepted, is fashioned and put together in this workshop; it is therefore the most important part of the factory. It extends perhaps eighty or ninety feet in length, and contains all the implements and arrangements for forming the wood-work of vehicles. Coaches, chariots, cabriolets, and other forms of vehicle, are seen in various parts of the shop or loft, and in various stages of progress. Work-benches are placed round the sides, on which the pieces of wood are fashioned and prepared; while the centre contains the carriages in progress.

Again we ascend to another story equal in size to the lower, and occupying the upper part of the building. This story is appropriated to two distinct workshops or lofts, the 'painting-loft' and the 'trimming-loft.' The former of these is nothing more than a large painting-shop, so far as regards the general arrangement. The coaches and other vehicles, in a certain stage of progress, are drawn up into this upper floor in order to be painted. In walking through this room we observed coaches undergoing the process of painting—others that of varnishing—others drying between the coats of paint or of varnish—others under the hands of the herald-painter. The 'trimming-loft,' on the same floor, is the room in which all the interior fittings of a coach are completed. Piles and rolls of morocco leather, of coach-lace, of silk, of broad-cloth, are lying around on benches and tables, and workmen are engaged in fitting the linings, cushions, fringes, and other interior decorations of private carriages.

After having quitted the main building of the factory, we cross the court-yard to the 'plater's loft.' This is a workshop in which many of the brass, steel, and plated articles belonging to a coach are either manufactured or else brought into a form fit for the coach-maker's use. It contains a 'drawing-bench,' for making the beading which is used so extensively at the edges of a coach, as well as other mechanical arrangements for working in metal.

It will thus be seen that the operations carried on within the walls of the factory are very varied, and

embrace the manufacture of articles differing totally in their materials and formation. Let us now proceed somewhat more into detail.

The first thing to be done in building a coach—as in building a house or a ship—is to draw the design, to display taste and invention in the plan and proportion, so as to combine comfort with elegance to the greatest possible degree. There must be an architect for a coach as well as for a house or a ship, and he is required to possess inventive ingenuity, as well as knowledge of geometrical forms. The working-drawing or design for a coach is sketched with chalk on a large smooth black board, and on the same scale as the vehicle to be constructed. The party for whom the coach is to be made has thus an opportunity of seeing the plan and proportions, and of suggesting alterations before practical operations are commenced. The elegance and costliness of a well-built private carriage render it quite as much an object of taste as of convenience; and thus the ingenuity of the coach-designer is constantly at work to devise improved forms and modes of arrangement in the various parts of a carriage. In addition to its elegance, too, a coach is constructed in a manner more and more conducive to the comfort of the inmates—a meed of praise which we cannot always give to the prevailing form of hats and coats, for the latter often teach us that fashion is an uncomfortable tyrant.

When the form and proportions are definitely arranged and clearly sketched on the board, a plan is adopted very similar to that observed in building a ship. The pattern of a ship (as we explained in the May 'Supplement') is drawn the full size, and a *mould* is formed of pieces of thin wood, adapted to all the chalk-marks in the sketch, and serving as guides to the shipwright in fashioning the hull of a ship. So it is with the coach-builder. He prepares a *mould* of a coach, that is, he places a series of thin pieces of wood to the chalk-marks on the board, shaping them in such a manner as to guide the saw and plane of the workmen hereafter. The chief reason for this similarity in the operation of the shipwright and the coach-builder, so far as regards the commencement of his operations, is found in the tortuous forms of the pieces of wood used in the structure. Without any further allusion to a ship, we may merely observe, that there is scarcely a right angle or a straight line throughout a coach. Curvatures of the most remarkable and complicated kind occur, which cannot be expressed in feet and inches; and thus it becomes necessary to have a type, a mould, a pattern of some kind or other, to transfer the required forms from the chalk sketch to the rough wood on which the workman is afterwards employed.

The sketch being formed, and the pattern-pieces prepared in conformity with it, the wood is selected fitted for the purpose. In the factory whose arrangements we have described above, there are two saw-pits—one for cutting wood in the 'round,' and the other for 'converting.' The 'round' is the technical appellation for wood just in the form in which it is cut, before being squared, and in this form a large quantity of timber is stowed away in the factory. The operations of the sawyer, by which the trees are cut into planks, are of the usual kind, and require no particular nicety.

When the wood is cut into planks, it is 'converted' in the other pit. This term (which is also used by shipwrights in an analogous manner) relates to the cutting of the planks into the required forms by means of the pattern-pieces, and requires much more taste and judgment; the rougher and larger pieces only are cut here, the smaller being shaped above-stairs. A word or two may here be said on the varieties of wood employed by the coach-builder. Ash is used very largely in the construction of coaches; the quality called 'hedge-row' ash is a tough fibrous wood, with which the principal parts of the frame-work of a coach are constructed; it is not liable to warp or twist, and thus becomes for many purposes a valuable kind of timber. Beech is a cheap kind of wood, never used by builders of the best coaches. Elm is employed for planking in those parts of the body of a coach requiring much strength, as also for the naves of wheels. Oak, in similar manner, is employed in various parts of coaches wherein strength and durability are required. Mahogany furnishes the material for the panels of the best coaches—those broad, smooth, and delicately curved surfaces which form the most conspicuous part of the body of a coach. Spanish mahogany, which the cabinet-maker selects as the most beautiful for his purposes, is not so useful to the coach-builder as the kind called Honduras, on account of the unfitness of its curled and twisted grain to conform to the bending which coach-panels receive. Deal and a few other kind of timber are used to a limited extent in coaches; but ash and mahogany are the two principal kinds.

The proper timber being selected for the various parts of a coach, it is taken up to the coach-making loft, where the operation of the maker commences. It may be here stated that the term 'carriage' is used by the workman in a sense different from that commonly employed. We speak indifferently of a *coach* or a *carriage;* but the coach-builders apply the latter term only to the frame-work which lies beneath or around the body, and which serves both to support the body and to connect it with the wheels, pole, &c. Hence there are two classes of workmen employed, the one called 'body-makers,' and the other 'carriage-makers;' the one employed principally on delicate frame-work and panelling, the other on stouter masses of wood. Body-makers may be regarded as the principal artisans employed in a coach-factory. They are required to possess a practical knowledge of complicated geometrical forms, and a very accurate hand and eye. The body of a coach is first put into shape by a skeleton frame-work of ash, every piece of which is more or less curved in one direction or another, and sometimes in double curvature. The meeting edges of the various pieces of wood are seldom at right angles to the surface, and various methods of joining are thereby rendered necessary; in some parts glue, in others bolts, nails, or screws; and in others those kinds of joints known to workmen by the names of the tenon-and-mortice joint, the lap-joint, and the groove. In forming the several pieces for the body of a coach, the workman makes constant use of the pattern or mould-pieces, by which he is guided in the curvatures given to the different parts. The actual working of the wood does not differ much from the operation of a joiner, planes and the customary joining tools being alike employed by each. Not only are the skeleton pieces of the frame-work jointed together with great nicety, but equal or even still greater care is required in preparing the grooves for the reception of the mahogany panels. The panels themselves are brought to the symmetrical and elegantly curved forms which they present, partly by the plane, and partly by the united action of heat and moisture. If a thin plank be wetted on one side and heated on the other, it will speedily become convex on the moistened side and concave on the other: and the workman is enabled to make these forms permanent.

The experience and tact requisite for this department of coach-building have the usual effect on the relation between master and workman; the latter can command a high rate of wages, as high, we believe, as from three to five guineas per week. Coach-body

makers, indeed, rank among the highest order of London artisans; the number of first-rate workmen in that branch is limited, and does not appear likely to increase in any great degree.

The reader will then understand that the *body* of a carriage, *i.e.* that part in which the sitters are placed, is made by a class of workmen different from those who make the under part of a carriage; that the wood of which the body is principally formed (in the larger and more important factories) is principally ash and mahogany; that the workman fashions the various pieces by the aid of a pattern-board, as in the process of ship-building: that the actual process of working the wood is a superior kind of joiner's work; and that the operations are conducted in that floor of the building called the 'coach-making loft.' While the body of a coach is thus in the process of formation, the other parts are being made by other sets of workmen; the 'carriage-makers' are employed on the complicated mechanism beneath the body; the smiths are preparing the numerous pieces of iron required in various parts of the coach; and the wheelwrights are making the wheels. Perhaps we may as well introduce in this place the few observations we have to offer on the subject of wheel-making. The business of a wheelwright is totally distinct from that of a coach-builder; no establishment of the latter kind, we believe, being in the habit of making the wheels for their own coaches. But although the operations of the wheelwright are thus not strictly connected with the title of this paper, yet we think it desirable to put our coach upon wheels before presenting it to the reader; and shall therefore briefly describe the operations of wheel-making as carried on at the extensive factory of Messrs. Curll and Glover, Sutton Street, Soho.

A coach-wheel is a remarkable instance of lightness combined with strength; and not less remarkable for the accuracy of hand and eye required in its construction. As a matter of principle, a large flat circular piece of wood, with a hole in the centre, would form a wheel; and in many countries forms the only kind of wheel used at the present day; but practice shows that a much smaller quantity of material is capable of being wrought into a wheel excelling not only in elegance, but also in durability, such rude productions. The essential parts of a modern wheel are the *nave*, the *spokes*, and the *felloes*, corresponding to the centre, the radii, and the circumference of a circle. The nave is a short block of wood, usually elm, forming the middle of the wheel, and pierced with a hole to receive the axle or axle-tree. The spokes are bars of oak, radiating from the nave at equal distances one from another, and extending to equal distances from the nave. The felloes are circular segments of ash, framed on the extremities of the spokes, and joined one to another so as to form a circle. To these parts must be added the *tire*, an iron hoop which binds all the felloes closely together.

The mass of elm intended for the nave is turned to the required dimensions and shape in a lathe, and is hollowed within to receive the axle. It is then fixed in a kind of groove, with its axis horizontal; and the mortices or holes are chiselled out, for the reception of the ends of the spokes. This is a nice and difficult operation, requiring a practised eye for its proper execution, on account of the peculiar direction in which the spokes radiate from the nave of a wheel. If we stand at a short distance behind a carriage, we shall perceive that the wheels are not flat, but that they are concave on the outer surface and convex on the inner; the lower spokes are nearly in a vertical position, while the upper spokes branch out at a considerable angle from the vertical. There are various reasons for this form, some of which relate to the strength of the vehicle, some to the increase of room for the body of the coach without increasing the width of the track of the wheels, and some to the preservation of the coach from splashing. The holes for the spokes have therefore to be chiselled in conformity with this 'dishing' of the wheel, as the conical form is called; and not only so, but half of the spokes are placed nearer to one end of the nave, and the other half to the other, for the sake of increasing the strength, and thus the holes have to be made at different parts of the nave's length.

The pieces of oak for the spokes are brought to the factory in lengths of about four feet, and are then shaped by hand to the light and elegant forms with which we are familiar. The lengths of the spokes must of course depend on the diameter of the wheel. The front wheels of a modern coach are from forty to forty-four inches in diameter; and the hind wheels from fifty to fifty-six inches. The front wheels have usually twelve spokes, and the hind wheels fourteen. A plane, the usual aid to a workman in giving a smooth surface to wood, cannot be employed in preparing the spokes, on account of the varying curvatures which they present; a small cutting tool called a 'spoke-shave' is the principal instrument employed. One end of each spoke is formed into a tenon to fit the mortice-hole in the nave; and the spokes are fixed by the operation of 'speeching,' or 'spoking,' represented in the annexed cut. The nave is placed in a kind of

socket at a short distance above the ground, in a part of the workshop where a cleft is made in the floor to receive the spokes as the nave is gradually turned round; and the spoke is then driven into the hole prepared for it, by repeated blows with a mallet. The spokes are partially shaped before being driven into the nave, and are finished afterwards.

The rim of a wheel is formed of several distinct pieces called *felloes*, each felloe being long enough to receive the ends of two spokes. The ash of which they are formed is brought to the factory in short roughly-curved pieces, and are afterwards shaped to the proper form and dimensions by means of pattern-boards and various cutting tools. When the felloes are formed, they are fixed firmly on a low bench, and four circular holes are drilled in each piece, two to receive the ends of the spokes, which are formed into cylindrical tenons, and two for joining the felloes end to end. For the latter purposes, short cylindrical pieces of oak, about three inches long, and called 'dowels,' are made, and being fitted to corresponding holes made in the ends

of the felloes, serve to unite them one to another. Wedges are inserted when required, and the whole become thus firmly combined in the form of a wheel.

But the piecemeal manner in which the circumference of the wheel is thus made up would ill qualify it for service, were not a strengthening hoop of iron fitted on. Formerly straps of iron, called 'strakes,' were applied to the surfaces of the felloes, covering the joints; but after a time an improved method came into use, which consists in the application of a solid iron-hoop, which is put on the wheel while hot, and by shrinking as it cools, forces the whole of the framing together into a firm body. The process of 'hooping' or 'tiring' a wheel is represented in the annexed cut. In an open court of

the wheel-factory is a circular flat iron-plate, placed in a horizontal position, with a vertical axis or stem rising from its centre. The wheel is placed down on this plate, the concave or 'dished' side downwards; the nave resting in a hole in the plate, and the wheel being fixed to the central stem. Immediately adjoining this circular plate is a small furnace adapted for the reception of the hoop or tire, which has been previously welded to the required size; and when the tire is brought to a proper heat, it is taken from the furnace, and by means of iron instruments fitted to the circumference of the wheel. The diameter of the tire is such that it would not fit on the wheel while cold, but being expanded by heat, it encompasses the wheel, and gradually clings tightly to it as it gets cold. To aid in this, two men beat the tire with powerful hammers, while the two others cool the iron by sprinkling it with water. Iron pins are subsequently driven through the tire and felloes, one on each side of every joint, the points being securely riveted inside the felloes. Iron hoops are also placed round the projecting parts of the nave, to enable it better to resist the strain to which it is subjected.

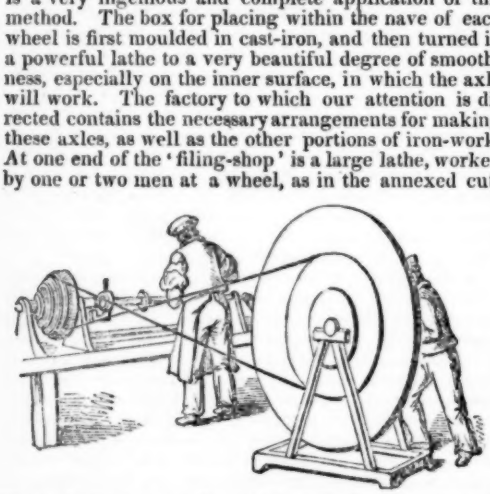
This brief notice will serve to convey some idea of the manufacture of the wheels of a coach. The process of painting them is one which we need not notice here; we shall therefore transfer our attention again to the coach-factory. The frame-work by which the body of a coach is connected with the wheels is, as we before observed, called the 'carriage,' and is the production of a class of workmen called 'carriage-makers.' These artisans are not required to produce such delicate work as the 'body-makers,' the masses of wood being much more heavy, and the joints fewer in number. Ash and elm are the principal kinds of wood which they use. It would be quite impossible, and, if possible, wholly uninteresting, to enumerate here all the various pieces of wood which constitute the frame-work of a carriage, some to connect the fore and aft wheels in pairs, some to connect the pairs of wheels together, some to support the body, others to support the coach-box, others again for the footman's standing-place behind, and others for the attachment of the horses to the coach. It is necessary to mention, however, one peculiarity in which a four-wheeled coach differs from many other forms of vehicle. In some coaches the body is connected with the under frame-work by pliable braces of leather attached to the springs; and in this case, the frame-work which supports the fore and hind springs is connected together by a long central piece of timber plated with iron, and called the 'perch.' An iron perch, called a 'crane-neck,' is sometimes used instead of a wooden one, and is shaped so as to enable the coach to turn somewhat more readily in a narrow street or road, an advantage which is however gained at the expense of greater weight of material.

As to the mode in which the carriage-makers proceed with their work, little need here be said. The planks and pieces of ash are roughly shaped by the saw, and are then worked to the proper contours, partly by planes, but much more by tools more or less resembling spoke-shaves.

We have before had occasion to notice the large quantity of iron-work prepared at the smith's shop in this factory. This iron is applied to various parts of a vehicle, and at different periods in the progress of the carriage towards completion. After the perch for a coach is made, and before it is fitted to the other parts of the framing, the smith takes it in hand, and fits side-plates of iron to it, for the sake of increasing the strength. In like manner many other parts of the vehicle, as soon as the wood-work is to a certain extent completed, are bound, hooped, or strengthened with iron in various different ways. All the iron for these purposes is forged out of small bars to a form nearly approaching that required, and is then either turned or filed to a regular surface. Where a perch is made entirely of iron, great muscular force is requisite in welding the different pieces into one mass. Indeed, both strength and skill are required in a coach-smith, for he has to work large and heavy bars of iron into forms containing several unequal curves, and varying greatly in thickness. There is a curious gradation of talent, and consequently of wages, observable in the operations of coach-smiths. There are the *forge-men*, the *hammer-men*, and the *vice-men*, all earning different amounts of wages. A forge-man and a hammer-man generally work together, the latter being subordinate to the former, and indeed often paid by him. The forge-man is the responsible workman; he judges of the quality of the metal, regulates the curvatures, and exercises his skill in combining elegance with strength in the various iron-fittings required for the coach. The hammer-man aids him in his work, using the sledge-hammer under the direction of the forge-man, blows the bellows, keeps up the fire, and performs other offices subordinate to the labours of the forge-man. The wages of the forge-men are often from three to five guineas a week; but those of the hammer-men are very much lower in amount. The *vice-men* are those smiths whose work is at the vice instead of the anvil. They file and finish the various pieces of iron when forged, and prepare the iron for being fixed to the wood-work of the coach.

One of the most carefully executed parts of the iron-work of a modern coach is the *axle* or *axle-tree*. The axle is the piece of wood or iron which serves as a centre for the motion of the wheels. It was formerly made wholly of wood, and was then generally termed an axle-tree; but now that metal is frequently used instead of wood, the word 'axle' is more frequently used alone. Axles used formerly to be fixed firmly in the wheels, and to revolve beneath the vehicle; but now they are more frequently so made that each wheel revolves separately on them. The first iron axles introduced were of a rude construction, but successive

improvements have brought them to great perfection. The axle consists of three parts: the two *arms*, which pass into the naves of the wheels; and the *bed*, or central part, which connects the two arms together. At first, a hoop or ring was put within the hollow of the nave, to prevent the too rapid wear of the wood by the friction of the axle; but now the nave is lined with an accurately-fitted iron box, capable not only of receiving the axle with little friction, but also of containing a reservoir of lubricating oil. A modern construction, known by the manufacturers as Collinge's patent axle, is a very ingenious and complete application of this method. The box for placing within the nave of each wheel is first moulded in cast-iron, and then turned in a powerful lathe to a very beautiful degree of smoothness, especially on the inner surface, in which the axle will work. The factory to which our attention is directed contains the necessary arrangements for making these axles, as well as the other portions of iron-work. At one end of the 'filing-shop' is a large lathe, worked by one or two men at a wheel, as in the annexed cut.



The tools for turning the metal, as well as the general mechanism of the lathe, require considerable strength and power. In order to make the axle work more freely in the box, the inner surface of the latter is 'case-hardened,' that is, by a peculiar action of charcoal aided by heat the surface of the iron is to a small depth converted into steel, which, being harder than the original iron, is susceptible of receiving a finer surface, and of withstanding the wearing effects of friction.

The *springs* form another and very important part of the metal-work of a coach, and require a brief notice in this place. The object of a spring, whatever be the substance of which it is formed, is, by its elastic action between the wheels and the body of the coach, to diminish the concussion and irregular motion occasioned by the passage of the wheels over uneven ground. Leather might be used with a slightly elastic effect; wood is sometimes used in light one-horse vehicles; but iron or steel is the universal material for the springs of modern English coaches, and is generally applied in the form of elastic plates. The forms given to these steel springs are exceedingly varied, and contribute not a little to the general elegance of a coach. The earliest springs were formed of a single plate of steel; but in modern manufacture several plates are laid one on another, all bound in close contact, and yet free to bend independently of each other, by having the ends loose. The steel employed is prepared expressly for the purpose, and is brought by the rolling-mill to the thickness of about a quarter or three-eighths of an inch, and from one and a half to three inches wide. A compound spring, formed of several parallel plates, is hooped or bound together with an iron hoop shrunk on hot, and riveted. If it be a curved spring, the external plate is of course longer than the others, and is formed of thicker steel. All the plates are formed in a similar way. A piece of steel is cut to the required length, tapered and prepared at each end, and one or both surfaces are them 'middled,' that is, slightly hollowed by hammering. Near each end a slit is made about an inch long, in which a small rivet-head, attached to the next adjoining plate, may work. When four or more of such plates are combined, and hooped tightly in the centre, the ends are free to yield when any pressure is felt, and thus the pressure becomes equally shared by all. We may illustrate this action by the following supposition:—let a dozen laths be laid one on another, and bound or riveted tightly at both ends; they could not then be bent very far without fracture; but let them be bound only in the *centre*, and the whole will bend nearly as easily as a single lath, because the ends of each lath are free to conform to the curvature produced by the bending.

This cut represents the mode of forming one of the numerous variety of coach-springs. The assemblage of plates, after being prepared separately and laid one on another, is fixed firmly in a vice, and an iron band or hoop is hammered on, till it clasps the spring at the thickest part with great closeness. Before this is done, each plate is subjected to the action of the fire. It is first heated to a certain temperature, then plunged into water, then heated again till such a temperature is acquired as will ignite a small stick. These processes of 'hardening' and 'tempering' are requisite to the subsequent action of the spring. The plate is then 'set,' or hammered perfectly straight; then filed in all the parts which will be visible; and the plates are in this state ready to be combined in the form of a spring. The springs are built up much in this manner, whatever be their shapes or designations. As to the technical distinctions of the 'single-elbow spring,' the 'double-elbow spring,' the 'under-spring,' the 'nut-cracker spring,' the 'C spring,' the 'S spring,' and many others, we need merely here remark that they are various forms, adapted for different kinds of carriages, some for the coach, some for the phaeton, some for the cabriolet, &c., but that all are produced by similar trains of operation.

With respect to the numerous other pieces of iron-work required in a coach, and known to the workman by the technical names of plates, loops, stays, hoops, clips, bolts, steps, treads, joints, jacks, shackles, &c., all we can say is that they are specimens of smith's work requiring considerable skill and ingenuity.

The labours of the smith alternate, or rather, are simultaneous with those of the 'body-maker' and the 'carriage-maker,' and therefore we cannot profess to follow the precise order of proceeding. At certain

stages in the progress of the wood-work various pieces of iron are worked into their proper places, before other pieces of wood are connected together. This is particularly the case in 'carriage' mechanism beneath the body, in which a considerable quantity of iron is employed, the adjustment of which alternates with the work of the carriage-maker.

A remark may be applied to the 'coach-carver' similar to that applied to the 'coach-smith.' His labours are directed not to the coach as a whole, but to the several parts of it during their progress. A coach-carver must necessarily be a man of some taste, even if he only executes patterns designed by others, but much more so if he designs them himself. His operations are of two different kinds, the simplest being that of carving the beadings and mouldings of the body or carriage, and the more elaborate that of producing the foliage and ornamental tracery which add so much to the beauty of a well-built coach. In 'state-coaches' this species of decoration is profuse and very costly;* but every coach, however simple, contains more or less carving. The tools of the coach-carver resemble those of carvers in general: they are more distinguished for their excellence than for their number or their size; and the workman depends more on his own taste and invention than on any prescribed rules of proceeding. The coach-carver is indeed an artist, and as such is highly paid.

One of the most remarkable operations in the construction of a coach is that of covering the upper part with leather; remarkable, we mean, in respect of the manual dexterity required. The panels, the quarters or upper panels, and the roof of a coach are very thickly painted, both for beauty of appearance and for durability. But the higher class of coach-builders do not trust exclusively to this external preservative; they cover the roof, and the upper part of the front, back, and sides, with leather, previous to the process of painting. It might be supposed that a hide of leather is for this purpose cut into pieces, one for the roof, one for each side, and so on; but the whole is covered with one hide, free from any joints or divisions whatever, and yet made to adhere closely to the wood-work in every part without folds or wrinkles. The hide, which is of a large size and sound quality, is first thoroughly moistened throughout and thrown over the top of the coach, the edges hanging down on all sides. The currier then rubs or presses it down all over the roof, until it lies close and even in every part. He next proceeds to one of the sides, and in like manner rubs and scrapes the leather till all irregularities disappear. The leather is in that soft and pliable state, that it will yield to the movement of the tools, and enable the workman to fit it to every part of the coach with perfect closeness. A little consideration must show that a superfluous fold of leather will occur at each corner; yet by working it towards a central point at the back or front, the currier succeeds in erasing or pressing out all irregularities, and in producing a surface sufficiently flat and smooth for the subsequent operations of the painter. The division between the upper and lower portion of a coach is usually covered by beading of some kind or other, and the leather is trimmed or cut to this line of division. This operation of covering a coach is as important as it is curious; for if a puncture be made through the leather, and rain-water enter even in minute quantity, the surface will be uneven and disfigured.

The other portions of leather required in a coach need not much description. They consist principally of bands and straps of various kinds. The leather or hide is laid out flat on a board and cut to the required shapes by means of sharp knives. Pieces are stitched together, or buckles, loops, rings, or straps are fastened to them, in the same manner as harness-work generally is done. The workman sits at a low bench, and holding the piece of leather on which he may be at work between a pair of clams or boards, uses the awl and the sewing-twine in the same manner as the boot-maker. A horse's collar, and the general harness for a saddle-horse, do not come under the manufacturing arrangements of the coach-builder; but at the factory which we here describe, all the articles of leather required, either for the coach itself or for its attachment to the horses, are made within the walls of the building. A mode of employing leather in which much neatness and dexterity are required, is in covering the iron rails or bars which occur in gigs and phaetons, and other forms of private carriages. The leather, before being japanned or painted, is cut into strips, corresponding with the length and circumference of the rails to be covered, and is then tightly fitted on in a moistened state, the joints and angles being worked up with much nicety, and the meeting edges being stitched closely together.

A department of the coach-factory, very different from those which relate to the working of wood, iron, and leather, is that in which the painting, varnishing, and polishing are effected. The 'painter's-loft' is one in which a coach remains for a considerable period, and in which it receives no small share of its beauty of appearance. 'Coach-painting' is distinguished from ordinary house-painting by the large number of separate coats of paint laid successively one on another, and by the high degree of purity and polish given to the surface, rather than by any difference in the materials employed. The surfaces, whether of ash, oak, elm, deal, mahogany, iron, or leather, are coated so thickly with paint, that the materials themselves are effectually concealed. The paint is formed of the usual mineral colours, mixed with linseed oil and turpentine; and the varnish employed is that prepared from gum-copal, which, though slow in drying, is very durable.

The principal parts of a coach, such as the panels, the doors, the quarters, &c., receive as many as twelve or fifteen different coats of paint, each one being dried before the next following one is applied, and the whole being repeatedly smoothed or polished with rotten-stone, pumice, and similar substances. The earlier coats, as in house-painting, are termed the 'priming,' and are intended to form the foundation on which the subsequent coats are laid.

The earlier coats of paint are formed of white-lead and litharge, to which succeed many coats of white-lead and yellow-ochre. When this body of paint has been dried and smoothed, the layers of green, brown, yellow, or other selected colours are applied to those parts which are not customarily black, while black paint is laid on the parts just mentioned. A sufficient body of paint being thus laid on, the roof, the upper panels, and the sword-case (a protuberance at the back of a coach, introduced when gentlemen carried swords) are coated with several layers of black-japan, and the other parts of the coach receive six or eight coats of copal-varnish. The final process of polishing is deferred for some considerable time, to ensure the previous hardening of the varnish.

The painting of the wheels of a coach is done either by the coach-builder or the wheelwright, according to circumstances; but wherever it be effected, the process is nearly the same as for the 'carriage' part of a vehicle. The part of the coach-painter's work which requires the largest amount of care and neatness is that of 'picking-out,' or painting fine lines, scrolls, &c. of

* The carving of the present Royal state-coach of England, which was executed about eighty years ago, cost two thousand five hundred pounds!

one colour on a groundwork of a different colour. That portion of the painting which relates to the heraldic arms and crests is altogether distinct from the rest, and is the work of a higher class of artisans called 'herald-painters,' whose services are paid for at a high rate. The herald-painter can lay no claim to comparison with the portrait-painter or the landscape-painter; but still, the accuracy of design, the neatness and clearness of outline, and the vividness of colour which he must display, require far more taste than that displayed by coach-painters, and give a higher value to his time.

Those to whom a sixpenny ride in an omnibus is a luxury are but little aware of the delicacy, the elegance, and the attention to personal comfort displayed in the interior fittings of a pleasure-carriage. In one of the Comedies of the last century, there is a scene in which a 'fine gentleman' laments that he has been unsuccessfully to all the mercers about town, to select for his coach a silk lining which would "suit his complexion." We do not imagine that the fine gentlemen of real life are so fastidious; but it is very certain that considerable taste is displayed in selecting not only the material, but the colour of the coach-trimmings. The principal materials employed in this manner are fine Spanish cloths, rich, plain, and embossed silks, *embossed leather, richly woven lace, and horse-hair for* stuffing cushions. The cloth is of the finest kind, and the silk is woven expressly for these purposes at Spitalfields. The lace employed is made sometimes of worsted, sometimes of silk, and in other instances of both combined, and it is used as a binding or edging for various parts of the interior; the finest is called 'broad-lace;' the next is termed 'pasting-lace,' about half an inch broad, and is employed to cover and hide rows of tacks; and another kind, called 'seaming-lace,' is used to cover seams and edges. The roof, sides, and various other parts of the interior of a coach are first brought to a level surface by wadding and canvas, and are then lined with cloth or silk. Cushions are covered with cloth, silk, or morocco leather, and are stuffed with horse-hair. The bottom of the coach, and the folding steps which are shut up within the coach, are covered with carpet; and the neat appendages to the doors and windows are trimmed with cloth, lace, &c. in various ways. All these operations resemble very much those of the upholsterer, the cloth, lace, silk, and carpeting being in some places sewn and in others tacked down in their places. There is also a part of the *exterior* of a coach on which the trimmer is engaged, viz. the 'hammer-cloth.' This is a cloth covering to the coachman's seat, and is principally used for the more elegant kinds of coaches. The cloth of which it is formed is stiffened at the back, so as to enable it to fall in graceful folds. The upper and lower edges are trimmed with broad and rich lace; and the most conspicuous part of each side has usually an embroidered or chased crest. Temporary covers of oil-skin or some analogous substance are provided for the preservation of the hammer-cloth in wet weather.

A glance at the external appearance of a private carriage will show that iron is by no means the only metal employed in its construction, although it is by far the most important. Beading, plates, locks, hinges, handles, rings, buckles, crests, and ornaments of various descriptions, are made of one or other of the metals susceptible of receiving a good polish and of presenting a pleasing appearance. Brass is the principal metal employed for such purposes, or iron plated with a thin sheet of brass, where strength is required. Copper is slightly employed; so likewise is a white alloy of copper called 'white brass,' 'albata,' or 'German silver.' A considerable quantity of semi-cylindrical beading is used in various parts of a coach; and this is formed in a simple manner. An orifice is formed in an iron or steel plate, the exact pattern of the cross-section of the beading; and into this opening the end of a narrow slip of sheet-metal is introduced by a workman, as in the annexed cut This end is

seized by a kind of pincers on the other side, which are then drawn backwards by means of a winch at the farther end of the bench. The slip of sheet-metal is thus drawn forcibly through the pattern-hole in the plate, and acquires the required semi-cylindrical form. The metal is made very hot by the compression it undergoes. The concave side of the beading is afterwards filled in with some soft kind of metal, and is provided with points or studs for fixing it to the coach. Sometimes the beading is made of copper, in which case it is afterwards painted; sometimes of brass, if to be left exposed and bright; while for the best coaches the beading is made of a strip of sheet-copper which has had a sheet of thinner silver united firmly to it by pressure in a flatting-mill: in this case, of course, the beading is drawn with the silver side visible.

The operation of *plating*, it need perhaps hardly be observed, is that of covering some of the cheaper metals with a coating of silver, with a view to give to the article both a beauty of appearance equal to that of solid silver and a degree of strength not possessed by silver. Many articles of coach furniture are prepared in this way, the silver being first formed into leaves, sheets, or ribands, and then firmly united to the surface of the cheaper metal by a peculiar application of heat and dexterous manipulation.

The chased ornaments, the coach-lamps, and other appendages of a well-built private carriage, we must pass over without any particular notice. Eight pages form but a narrow field for the building of a coach; and we can only hope to have given a few general notions on this very diverse, complicated, and ingenious department of English manufacture.

END OF VOLUME THE TENTH.

*** The Office of the Society for the Diffusion of Useful Knowledge is at 59, Lincoln's Inn Fields.
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